

EXECUTIVE SUMMARY

This Resource Conservation and Recovery Act (RCRA) Facility Investigation Report (RFI Report) for the Chevron Refinery in Perth Amboy, New Jersey demonstrates compliance with Condition E1, and Appendix A, of Module III, Corrective Action Requirements for Solid Waste Management Units (SWMUs) in Chevron's Hazardous and Solid Waste Amendments of 1984 (HSWA) Permit (EPA ID No. NJD081982902).

The RFI is comprehensive and includes the results from new and previous investigations (1997-2002). This report addresses SWMUs and Areas of Concern (AOCs) in the North Field/Main Yard, East Yard and Central Yard only, and does not include units contained in the West Yard, Amboy Field or the North Field Extension, that are being addressed separately. In summary, the areas requiring investigation include:

- SWMUs, Solid Waste Management Areas (SWMAs) and AOCs identified in the permit as having the potential for a release;
- Light non-aqueous phase liquid (LNAPL) areas where LNAPL was found to be mobile and measurable; and
- Receiving surface water bodies and wetlands around the perimeter of the site.

Potential Areas of Concern (PAOCs) identified as having the potential for a release will be addressed in a separate deliverable.

Identifying potential sources of contamination is essential to understanding potential exposure pathways and to developing a technically sound remedial strategy. The Refinery has been dedicated to asphalt production and refining petroleum hydrocarbons since the late 1800's. Thus, a degree of industrial impact is expected to be present. In particular, the main sources of environmental impact at the Refinery are likely to be associated with:

- The historical practice of filling low areas with various materials, including potentially impacted fill, to facilitate development;
- Residuals in waste management units, such as oil/water separators, tetraethyl lead (TEL) burial sites, wastewater treatment system components and other units including the Oily Water Sewer System (OWSS); and
- Accidental spills and leaks from operational units and pipelines.

Objectives

In general, the RFI is expected to identify releases that resulted from accepted practices employed before the advent of modern waste management procedures and current regulations. The overall objectives of the RFI have been met including:

- Characterizing the source at each unit, if any;
- Determining whether a release has occurred from each unit;
- Determining the nature and extent of identified releases; and
- Where necessary, determining whether groundwater at the Facility has been affected by releases from the Units.

The distribution of the Facility-related constituents in soils, the characterization of the LNAPL and TEL areas, the delineation of petroleum hydrocarbon areas in groundwater and the evaluation of the potential migration pathways to surface water and sediment have been completed and are presented in this report.

Soils

From the over 800 soil samples taken and used in the RFI, approximately 40 constituents including tentatively identified compounds (TICs) were detected above their respective delineation criteria. The soil delineation criteria were identified as the most stringent of the applicable direct contact or impact to groundwater criteria and priority was given to the New Jersey Department of Environmental Protection (NJDEP) SCC. Many of the chemicals were detected infrequently. The most commonly detected Facility-related chemicals that were detected above their respective delineation criteria include benzene, PAHs (primarily benzo(a)pyrene) and metals (lead and total organic lead (TOL)). Arsenic and iron were the most frequently detected metals and are not considered to be Facility related.

In general, the vertical and horizontal delineation of these exceedances on an area or site-wide basis has been achieved. The Facility-related chemical impacts are generally contained within the fill layer.

Although arsenic has been detected in many of the soil samples from the Refinery, concentrations of arsenic are usually less than that considered to be background in New Jersey soils, as represented by the NJDEP SCC for both residential and industrial land use and various New Jersey soils (Sanders, 2003). In addition to naturally occurring background, anthropogenic, off-site activities (e.g., smelting and refining) may account for some of the higher arsenic soil concentrations (the maximum arsenic soil concentration was 117 mg/kg). Alternatively, these higher concentrations may represent background concentrations as well, since elevated arsenic soil concentrations have been found to be naturally occurring in New Jersey (e.g., marine clay), where total arsenic levels have been reported to range from 13 to 131 mg/kg (Sanders, 2003). Therefore, arsenic is not considered a Facility related-chemical.

Site-wide exceedances of soil delineation criteria associated with PAHs (particularly benzo(a)pyrene), while petroleum constituents, were widespread and inconsistent with a pattern of spills and releases (i.e., not attributable to known waste management units, but more likely associated with the historical practice of filling low areas with potentially impacted dredge spoils and fill and Refinery materials to facilitate Refinery expansion).

In other areas, these exceedances are part of the LNAPL areas and are collocated with volatile organic compound (VOC) exceedances, predominantly benzene, representing the lighter end of the petroleum distillate range.

TEL

TOL has been detected in soils at the confirmed TEL burial sites, and in many cases has degraded to inorganic lead. Based on the RFI data and consistent with the literature, most of the lead associated with TEL has been retained, likely as stable, solid phase compounds, precipitates or complexes with organic matter. These forms of lead are quite insoluble and are unlikely to leach into groundwater unless acidic conditions are present.

LNAPL

As with all Facility-related potential impacts, LNAPL areas are contained in a manner that provides protection to human health and the environment:

- Seventeen LNAPL areas have been identified within the North Field/Main Yard, Central Yard and East Yard.
- Delineation has been completed at all 17 areas.
- Based on fingerprint analyses performed at 16 of the 17 areas, the LNAPL encountered at the Refinery is typically composed of weathered crude oil, refining residuals, weathered diesel and weathered gasoline.
- LNAPL is found at relatively shallow depths (less than 10 feet bgs) within the fill material, specifically within the more permeable lenses and layers of flyash and catalyst beads.
- Impacts are limited and stable, and not a threat to any sensitive receptors.
- Based upon the age and small apparent thicknesses, most of the LNAPL present appears to be relatively immobile in the subsurface.

Groundwater

The assessment of groundwater conditions at the Refinery has been based primarily on data collected from 120 monitoring wells. Two rounds of groundwater samples have been collected from these wells; Round One during the fourth quarter of 2002 and Round Two during the first six months of 2003. These samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs), metals and TICS.

From a site-wide perspective, the results of this study have provided sufficient information to develop a comprehensive model of the shallow groundwater conditions at the Refinery, including the hydrogeological setting and the distribution of Facility-related constituents of concern (COCs) (predominately benzene but also toluene, xylenes and ethylbenzene). In general, the surficial geology of the site consists of two to 20 feet of miscellaneous fill overlying native materials. The native materials immediately beneath

the fill consist of a reddish-brown till and dark gray organic clays interspersed with a significant layer of peat. The peat is primarily located in the northeastern and eastern portions of the site. The shallow water table has been found to be perched on this fill/native interface over much of the Refinery. The till and the organic clays have each been shown to be as great as 40 feet thick in various locations at the Refinery.

While several areas of groundwater impacted by dissolved phase constituents have been identified within the Refinery, data from the sentinel well system indicates that off-site migration of dissolved constituents, with the possibility of one exception, is not occurring. Furthermore, with one possible exception, the groundwater impacts are limited to the shallow, water-bearing zone within the fill. Chevron proposes to monitor the levels of specific VOCs for these areas to establish contaminant trends and to determine if the groundwater quality is improving.

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Surface Water and Sediment

A Baseline Ecological Evaluation (BEE)/Ecological Assessment (EA) for the Refinery was included in the RFI. This investigation was conducted, in part, to comply with the surface water and sediment investigation provisions of Chevron's RCRA Corrective Action Permit (RCRA Corrective Action Permit, Appendix A, Scope of Work for RFI) and requests by NJDEP for a BEE pursuant to NJDEP's Technical Requirements for Site Remediation (TRSR) Section 3.11.

The purpose of the BEE/EA was to identify the potential co-occurrence of:

- Contaminants of ecological concern at the site;
- Environmentally sensitive natural resources, as defined by the TRSR Section 1.8, within the site boundaries and/or on properties immediately adjacent to the site; and
- Potential migration pathways and impacts to on-site or adjacent environmentally sensitive natural resources that may be due to site operations.

As a result of the site inspection and a review of the available wetlands maps and NJDEP's geographical information system (GIS) data, the environmentally sensitive areas on or adjacent to the Project site include the Arthur Kill, Spa Spring Creek and Woodbridge Creek as well as associated wetlands areas located along the north, east and west site boundaries. There are no endangered/threatened species associated with the site and no observed impacts in the identified environmentally sensitive areas. Based on the BEE site inspection, the general conditions of the Kill, creeks and associated wetland areas appear to be similar to other estuarine surface water and wetland areas that are located in older, heavily industrial areas.

Based on the RFI data from the Refinery, the COPECs include benzene, toluene, ethylbenzene and xylene (BTEX) (soil and sediment), PAHs (soil and sediment) and metals, including copper, lead, mercury, nickel and zinc (soil, sediment and surface water).

Potential migration pathways were evaluated including the potential for stormwater discharges from overland flow, groundwater discharge to surface water, direct discharge of contaminants and potential off-site sources. Based on this review, groundwater migration along the site perimeter and surface water runoff are potential migration pathways to the adjacent tidal creeks and wetland areas from Chevron. However, stormwater runoff from the Refinery is collected and treated by the Refinery's Effluent Treatment Plant (ETP) prior to discharge. Also, groundwater migration and surface water runoff from off-site industrial properties and roadway runoff likely contribute contaminants to the adjacent tidal creeks and wetland areas.

The following conclusions are made:

- Background sources are likely contributing to elevated contaminant concentrations in surface water and sediment;
- Off-site sources are likely contributing to the presence of PAHs and metals in sediments; and
- Further evaluation of sediment is recommended for SVOCs and metals in Woodbridge Creek sediments.

Summary

The distribution of the Facility-related constituents in soils, the characterization of LNAPL and TEL areas, the delineation of petroleum hydrocarbon areas in groundwater and the evaluation of the potential migration pathways to surface water and sediment have been completed and general conclusions made. In general the impacts are:

- BTEX, PAHs and some metal soil impacts are primarily limited to the fill and/or are collocated with Refinery wastes (e.g., catalyst beads, flyash and oily fill), and only sporadic/isolated minor exceedances of the direct contact soil criteria have been detected in surface soil.
- TEL burial locations have been confirmed and most of the lead associated with TEL has been retained in soils, which in general does not pose a threat to groundwater.
- LNAPL areas are found at relatively shallow depths (less than 10 feet bgs) within the fill material (flyash and catalyst beads), and can be characterized as typically being composed of weathered crude oil, refining residuals, weathered diesel and weathered gasoline with limited, stable impacts and not a threat to any sensitive receptors.
- While several areas of groundwater impacted by dissolved phase constituents have been identified within the Refinery, data from the sentinel well system indicates that migration off-site, with the possibility of one exception, is not occurring.
- Elevated levels of PAHs and metals have been detected in sediments and to a much lesser extent in surface waters. Elevated concentrations were found at

background locations as well as locations adjacent to the Refinery. Off-site background sources are likely contributing to elevated contaminant concentrations. Based on the evaluation of on-site soil and groundwater conditions, there is no indication of ongoing discharges of these substances from the site.

- The data obtained from the RFI will allow Chevron to develop cleanup goals and begin the Corrective Measures Study (CMS) pursuant to the HSWA Permit.

Table ES-1. RFI HSWA Permit Status

SWMU /AOC	Designation	Soil Investigation Status	Groundwater Investigation Status
SWMA 1	SWMU 27, 29, 39 & AOC 5, 7	CMS	CMS
SWMA 2	SWMU 28, 30, 38	CMS	NFA Recommended
SWMA 3	SWMU 5, 21, 43	CMS	CMS
SWMU 1	North Field Basin (Closure)	Under Closure	Under Closure
SWMU 2	Surge Pond (Closure)	Under Closure	Under Closure
SWMU 3	East Yard Basin (Closure)	NFA	NFA
SWMU 4	Landfarm (Closure)	NFA	NFA
SWMU 6	TEL Burial (north - Tank 306)	CMS	CMS
SWMU 7	TEL Burial (east - Tank 305)	CMS	NFA Recommended
SWMU 8	TEL Burial (northwest - EYB)	CMS	CMS
SWMU 9	TEL Burial (north - Tank 753)	NFA	CMS
SWMU 10	2 TEL Burials (southwest - Tank 771)	CMS	CMS
SWMU 11A	TEL Burial (along RR tracks)	CMS	NFA Recommended
SWMU 11B	2 TEL Burials (along RR tracks)	NFA Recommended	NFA Recommended
SWMU 12	3 TEL Burials (west - Tank 27)	CMS	CMS
SWMU 13	TEL Burial (west - Tank 28)	NFA Recommended	CMS
SWMU 14	2 TEL Burials (east - Tank 23)	NFA Recommended	NFA Recommended
SWMU 15	TEL Burial (south - Tank 14)	CMS	CMS
SWMU 16	TEL Burial (south - Tank 306)	CMS	CMS
SWMU 17	TEL Burial (east - Tank 301)	CMS	CMS
SWMU 18	TEL Burial (west - Tank 301)	CMS	CMS
SWMU 19	TEL Burial (west - Tank 326)	CMS	CMS
SWMU 20	TEL Burial (east - Tank 302)	CMS	CMS
SWMU 22	TEL Burial (east - Tank 329)	CMS	CMS
SWMU 24	TEL Weathering (east - Tank 9209)	CMS	CMS
SWMU 25	TEL Burial (northeast - EYB)	NFA	NFA
SWMU 26	TEL Burial (south - EYB)	Resample recommended	Resample recommended
SWMU 31	Effluent Treatment Plant	NFA	NFA

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SWMU /AOC	Designation	Soil Investigation Status	Groundwater Investigation Status
SWMU 32	PCB Waste Storage Building	NFA	NFA
SWMU 34	Dumpster and Drainage Area	CMS	CMS
SWMU 35	No. 4 Separator (& AOC 6A)	CMS	CMS
SWMU 36	Oil/Water Separator	CMS	NFA Requested
SWMU 40	Old Pond	CMS	CMS
SWMU 41	Drying Area	CMS	NFA Requested
SWMU 42	East Yard Crude Slab	CMS	CMS
SWMU 44	Unnamed Main Yard Pond	NFA Recommended	NFA Recommended
SWMU 45	Surface Impoundment (south - EYB)	NFA	NFA
SWMU 51	Oily Soil Pad	NFA	NFA
SWMU 52	TEL Burial (southwest - Tank 13)	NFA Recommended	CMS
SWMU 53	Potential Discharge - Tank Basin 312	CMS	CMS
AOC 1	Potential Discharge - Tank 1	Remediation Planned	Remediation Planned
AOC 2	Potential Discharge - Tank 3	NFA	NFA
AOC 3	Potential Discharge - Tank 4	Remediation Planned	Remediation Planned
AOC 6A	Oil Material (B26 & B34)	Incorporate into SWMU 35	Incorporate into SWMU 35
AOC 6B	Oily Material (B-29, B-30 & B31)	Incorporate into EY4A	Incorporate into EY4A
AOC 6C	Oily Material (B32 & B33)	NFA Recommended	NFA Recommended
AOC 8	Oily & Tarry Material at B-27 & B-28	CMS	CMS
AOC 9A	Contamination at NF-10	NFA Recommended	CMS
AOC 9B	Contamination at NF-11	NFA Recommended	CMS
AOC 10	Stained Soil & Gravel Near IAF Tank	CMS	CMS
AOC 13	Oily Fill Material (B-11)	NFA Recommended	NFA Recommended
AOC 14	GWQAP Oily Fill Area III	Incorporate into EY4A	Incorporate into EY4A
AOC 15	Oil Release at Buckeye Pipe Manifold	Incorporate into AOC 8/NF6	Incorporate into AOC 8/NF6
AOC 16	Oily Water Sewer System	CMS	CMS
AOC 17	Potential Discharge - Tank 20	Remediation Planned	Remediation Planned
AOC 18	Potential Discharge - Tank 2	CMS	CMS

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SWMU /AOC	Designation	Soil Investigation Status	Groundwater Investigation Status
AOC 19	Main Yard Pipeway	CMS	CMS
AOC 20	Aboveground Product Pipe Manifold	Remediation Planned	NFA Recommended
AOC 21	Maurer Road Excavation / SS Loading Rack	CMS	CMS
AOC 22	Shops Building GW Contamination	NFA	CMS
AOC 23	Tank Basin 327	CMS	CMS
AOC 24	Release at Fire Hydrant (NW-Tank 4)	NFA Recommended	NFA Recommended
AOC 25	Release at Former Cat Cracker	CMS	CMS
AOC 26	East Yard Bunker Slab	Incorporate into EY4B	Incorporate into EY4B
AOC 27	Tank 777 Pipeway	CMS	CMS
AOC 28	Asphalt Plant Tanks	CMS	NFA Recommended
AOC 29	5 Berth Coal Tar	CMS	CMS
AOC 30	Tank 27 Pipeway	CMS	NFA Recommended
AOC 31	Tank 772 Pump Pad	CMS	CMS
AOC 32	Tank 16 Basin	NFA Recommended	NFA Recommended
AOC 33	Tank 314 Basin	CMS	CMS
AOC 34	Tank 315 Basin	CMS	CMS
AOC 35	Tank 771 Basin	NFA Recommended	NFA Recommended
AOC 36	Chlorinated Hydrocarbons in Groundwater	Investigation Required	CMS